DFLX 33

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date:January 6, 2003 Page 1 of 1 Author: Sandor Feher
	0. Cover Sheet for Check Out Form	

Power leads being tested: 7500 A DFLX 33 7500 A DFLX 34

Task #	Responsible	Task	Received Date,time		Performed Date,time	
1	Inspection	Unpack the leads			5/23	
2	Inspection	IB4 mech. & Tolerances			5/23	
3	Mechanical	Move the leads to MTF			6/30	
4	Electrical	Initial electrical check out			6/13	
5	Mechanical	Installation of the current leads			7/16-7/17	
5a	Mechanical	Preliminary leak check Procedure			7/2	
6	Mechanical	Pressure test			7/17	
7	Mechanical	Leak check			7/22	
7a	Mechanical	Top plate insertion into the dewar			7/22	1330
8	M. Tartaglia	Configuration of the DAQ system			7/23	0830
9	Electrical	Room temp. electrical test	7/22	13:30	7/23	11:45
10	Mechanical	Installation of the top plate	7/23	11:45	7/23	15:03
12	Mechanical	Cool down			7/24	0700
13	Electrical	Electrical & instrumentation test	7/24	9:00	7/24	12:45
14	Mechanical	Connect the leads to the Power Supply & configure			7/24	1335
15	Electrical	Electrical & instrumentation test	7/24		7/24	17:00
16	M. Thompson	Cold test of the power lead			7/25	1200
17	Mechanical	Perform a Thermal cycle			7/25	1630
18	M. Thompson	Cold test of the power lead			7/28	1200
19	Mechanical	Warm up			7/28	1615
20	Electrical	Electrical & instrumentation test	7/29		7/29	1215
21	Mechanical	Remove the top plate			7/30	0800
22	Mechanical	Remove the leads from the top plate			7/30 - 7/31	
23	Mechanical	Pack and move the leads			7/31	

→ 10.1 High Pot in HE 7/23 15:03 7/23 15:46

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date:January 6, 2003 Page 1 of 1 Author: Sandor Feher
	1. Unpacking Check Out Form	

Performed by SUDHIR GHANTA
(name typed) (signature)

Date & time 5/23/03 10.10 AM

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

1.1 Container Identification: 7500 A DFLX 33 7500 A DFLX 34
(Leads serial numbers are on one side of the container)

1.2 Note condition of shipping container
No damage ☑ Slight damage ☐ Massive damage ☐

1.3 Examine condition of g-load indicators

a. Each side of the box are Shock Watch-s are installed

Not tripped ☑ Tripped (red) ☐ Remark: ________

Not tripped ☑ Tripped (red) ☐ Remark: ________

b. Each leads have a Shock Watch installed onto their body

Not tripped ☑ Tripped (red) ☐ Remark: ________

Not tripped ☑ Tripped (red) ☐ Remark: ________

c. Each leads have another "10G DROP" devices installed on the flag of the leads

Not tripped ☑ Tripped (Black) ☐ Remark: 33

Not tripped ☐ Tripped (Black) ☑ Remark: 34 BOTTOM ARROW.

1.4 Container content:

a. Power leads: 7500 A DFLX 33 ; 7500 A DFLX 34
b. Travel document for each lead in an envelope ☑
c. In a plastic box:
   1. One clamp: Item No. C105-12-401; Description NW16/10 Clamping ring ST/STEEL PK1 ☑
   2. One valve made by "precision Cryogenic System" ☑
   3. One O-ring seal with brass insert ☑

SOME OTHER PARTS.

Review of Pirelli Traveller DFLX 33 & DFLX 34

HTS Lead #	Pr Test	Leak Test	Volt Test	Small Hole Pos O/T	Small Hole Size O/T	Large Hole Pos O/T	Dist Between Holes O/T
DFLX33	OK	OK	OK	0.0018	OK	OK	OK
DFLX34	OK	OK	OK	0.0029	0.0006	OK	OK

PART NAME : 7.5 KA CURRENT LEAD ASSY (LE
REV NUMBER :
SER NUMBER :
STATS COUNT : 1

7500A DFLX 33

MM	DIM CYL -A-DIA= LOCATION OF CYLINDER CYL -A-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	99.000	0.200	0.200	99.052	0.052	0.000

MM	DIM -A-= ROUNDNESS OF CYLINDER CYL -A-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.200	0.000	0.084	0.084	0.000

MM	DIM -B-= FLATNESS OF PLANE PLN -B-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.050	0.000	0.004	0.004	0.000

MM	DIM PERP1= PERPEND OF PLANE PLN -B- TO CYLINDER CYL -A- EXTEND=0.000					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.400	0.000	0.157	0.157	0.000

MM	DIM PERP2= PERPEND OF PLANE LRG FLANGE TO CYLINDER CYL -A- EXTEND=560.000					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.400	0.000	0.251	0.251	0.000

MM	DIM -C- DIA= LOCATION OF CYLINDER -C-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	80.000	0.200	0.200	79.930	-0.070	0.000

MM	DIM CONCEN2=CONCENTRICITY FROM CYLINDER -C- TO CYLINDER CYL -A-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	1.000	0.000	1.563	1.563	0.563

MM	DIM RND2= ROUNDNESS OF CYLINDER -C-					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	0.000	0.200	0.000	0.068	0.068	0.000

MM	DIM DIST1= 2D DISTANCE FROM PLANE PLN -B- TO PLANE LRG FLANGE PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	561.000	1.000	1.000	561.441	0.441	0.000

MM	DIM LOC5= TRUE POSITION OF CIRCLE CIR2						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	0.000				0.000	0.000	
Z	123.571				123.396	-0.175	
DF	18.000	0.200	0.200	0.177	17.977	-0.023	0.000
TP	MMC	0.130		0.177		0.350	0.044

MM	DIM LOC10= TRUE POSITION OF CIRCLE CIR3						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	-78.890				-78.955	-0.066	
Z	95.047				94.906	-0.141	
DF	18.000	0.200	0.200	0.177	17.977	-0.023	0.000
TP	MMC	0.130		0.177		0.312	0.005

MM	DIM LOC11= TRUE POSITION OF CIRCLE CIR4						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
X	78.890				78.947	0.056	
Z	95.047				94.895	-0.152	
DF	18.000	0.200	0.200	0.178	17.978	-0.022	0.000
TP	MMC	0.130		0.178		0.324	0.016

MM	DIM LOC12= TRUE POSITION OF CIRCLE CIR5							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
X	78.890				78.948	0.058		
Z	-95.047				-95.179	-0.132		
DF	18.000	0.200	0.200	0.171	17.971	-0.029	0.000	
TP	MMC	0.130		0.171		0.288	0.000	

MM	DIM 16.00 DIA HOLE #5= TRUE POSITION OF CIRCLE CIR6							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
X	-78.918				-78.954	-0.037		
Z	-95.047				-95.162	-0.115		
DF	18.000	0.200	0.200	0.125	17.925	-0.075	0.000	
TP	MMC	0.130		0.125		0.242	0.000	

MM	DIM 8.433 DIA HOLE #1= TRUE POSITION OF CIRCLE SH1							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.670	0.120		
PA	-153.000				-152.956	0.044		
DF	8.433	0.200	0.000	0.098	8.531	0.098	0.000	
TP	MMC	0.080		0.098		0.278	0.099	

MM	DIM 8.407 DIA HOLE #2= TRUE POSITION OF CIRCLE SH2							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.658	0.108		
PA	-171.000				-170.930	0.070		
DF	8.433	0.200	0.000	0.097	8.530	0.097	0.000	
TP	MMC	0.080		0.097		0.310	0.132	

MM	DIM 8.433 DIA HOLE #3= TRUE POSITION OF CIRCLE SH3							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.680	0.130		
PA	-135.000				-134.980	0.020		
DF	8.433	0.200	0.000	0.095	8.528	0.095	0.000	
TP	MMC	0.080		0.095		0.268	0.093	

MM	DIM 8.433 DIA HOLE #4= TRUE POSITION OF CIRCLE SH4							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.584	0.034		
PA	171.000				171.083	0.083		
DF	8.433	0.200	0.000	0.098	8.530	0.098	0.000	
TP	MMC	0.080		0.098		0.271	0.094	

MM	DIM 8.433 DIA HOLE #5= TRUE POSITION OF CIRCLE SH5							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.545	-0.005		
PA	153.000				153.106	0.106		
DF	8.433	0.200	0.000	0.094	8.527	0.094	0.000	
TP	MMC	0.080		0.094		0.336	0.162	

MM	DIM 8.433 DIA HOLE #6= TRUE POSITION OF CIRCLE SH6							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.462	-0.088		
PA	135.000				135.120	0.120		
DF	8.433	0.200	0.000	0.091	8.524	0.091	0.000	
TP	MMC	0.080		0.091		0.417	0.246	

MM	DIM 8.433 DIA HOLE #7= TRUE POSITION OF CIRCLE SH7							
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL	
PR	90.550				90.396	-0.154		
PA	117.000				117.095	0.095		
DF	8.433	0.200	0.000	0.091	8.523	0.091	0.000	
TP	MMC	0.080		0.091		0.431	0.260	

MM	DIM 8.433 DIA HOLE #8= TRUE POSITION OF CIRCLE SH8						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.340	-0.210	
PA	99.000				99.071	0.071	
DF	8.433	0.200	0.000	0.097	8.530	0.097	0.000
TP	MMC	0.080		0.097		0.475	0.298

MM	DIM 8.433 DIA HOLE #9= TRUE POSITION OF CIRCLE SH9						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.353	-0.197	
PA	81.000				81.011	0.011	
DF	8.433	0.200	0.000	0.093	8.526	0.093	0.000
TP	MMC	0.080		0.093		0.397	0.224

MM	DIM 8.433 DIA HOLE #10= TRUE POSITION OF CIRCLE SH10						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.346	-0.204	
PA	63.000				62.989	-0.011	
DF	8.433	0.200	0.000	0.087	8.519	0.087	0.000
TP	MMC	0.080		0.087		0.410	0.243

MM	DIM 8.433 DIA HOLE #11= TRUE POSITION OF CIRCLE SH11						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.372	-0.178	
PA	45.000				44.927	-0.073	
DF	8.433	0.200	0.000	0.094	8.526	0.094	0.000
TP	MMC	0.080		0.094		0.424	0.251

MM	DIM 8.433 DIA HOLE #12= TRUE POSITION OF CIRCLE SH12						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.437	-0.113	
PA	27.000				26.895	-0.105	
DF	8.433	0.200	0.000	0.097	8.530	0.097	0.000
TP	MMC	0.080		0.097		0.401	0.224

MM	DIM 8.433 DIA HOLE #13= TRUE POSITION OF CIRCLE SH13						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.502	-0.048	
PA	9.000				8.898	-0.102	
DF	8.433	0.200	0.000	0.095	8.528	0.095	0.000
TP	MMC	0.080		0.095		0.337	0.162

MM	DIM 8.433 DIA HOLE #14= TRUE POSITION OF CIRCLE SH14						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.508	-0.042	
PA	-9.000				-9.077	-0.077	
DF	8.433	0.008	0.000	0.008	8.528	0.096	0.088
TP	MMC	0.003		0.008		0.259	0.248

MM	DIM 8.433 DIA HOLE #15= TRUE POSITION OF CIRCLE SH15						
AX	NOMINAL	+TOL	-TOL	BONUS	MEAS	DEV	OUTTOL
PR	90.550				90.574	0.024	
PA	-27.000				-27.107	-0.107	
DF	8.433	0.200	0.000	0.100	8.533	0.100	0.000
TP	MMC	0.080		0.100		0.342	0.162

MM	DIM 1450= 2D DISTANCE FROM LINE FRT END TO LINE LIN2 PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	1450.000	0.400	0.400	1452.554	2.554	2.154

MM	DIM 130.0DIA= LOCATION OF CIRCLE OD1					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
D	130.000	0.200	0.200	129.909	-0.091	0.000

MM	DIM 502 COOLING HOLE= 2D DISTANCE FROM CIRCLE ID15 TO PLANE LRG FLANGE PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	502.000	0.400	0.400	501.472	-0.528	0.128

MM	DIM X LOC OF COOLING HOLE= LOCATION OF CIRCLE ID15					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
X	0.000	1.800	1.800	0.392	0.392	0.000

DEG	DIM WARM TERMINAL= 3D ANGLE (TRUE) FROM PLANE PLN2 TO ZAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
A	0.000	0.100	0.100	-0.107	-0.107	0.007

MM	DIM X LOC OF WARM TERM= LOCATION OF PLANE MID PLN					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
X	0.000	0.130	0.130	0.155	0.155	0.025

IN	DIM POLAR ANGLE OF COOLING HOLE= LOCATION OF CIRCLE ID15					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
PA	90.000	2.000	2.000	89.551	-0.449	0.000

MM	DIM 444.5= 2D DISTANCE FROM LINE FRT END TO PLANE PLN -B- PAR TO YAXIS					
AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
M	444.500	1.500	1.500	445.463	0.963	0.000

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	3. Form for moving power leads	

Power leads need to be moved from NW8 to MTF are:
7500 DFLX 33 & 7500 DFLX 34
Approved by 6/20/03 SandorFeher Feher Sandor
(name typed) (signature)
Date & time

The request should go through Marsha Schmidt who is responsible keeping track of whereabouts of the power leads.

Requested by ROGER RABEHL Roger Rabehl
(name typed) (signature)
Date & time 6/26/03 10:25

Delivered by CLIFF BESCH
(name typed) (signature)
Date & time 6/30/03

Received by DEAN VALINIS
(name typed) (signature)
Date & time 6-30, 0743

The next person ____________ responsible to perform Checkout form #5 (5. Installation of the current leads into the top plate) has been

Notified by
(name typed) (signature)
Date & time

This form should be copied and each copy should be placed into the folders of both of the power leads

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date:January 15, 2003 Page 1 of 2 Author: Fred Lewis
	4. Initial Electrical Checkout	

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

Performed by DAN EDDY (name typed) Dan Eddy (signature)

Date & time 6-13-03 10:00

Power Lead 7500 A DFLX 33

When checkout is complete, make sure you place this document in the Traveler Binder

3.1 Voltage segment and drop measurement.

Apply 5 Amps between the copper flag and the LTS cable.

Record the applied current 5 A

Use HP3458 DVM, set it to 40 line cycle integration time.

Measure the voltages between the following pins:

Voltage tap Connector 1 (Primary) (Fisher DEE104A06)

Pin 1 - pin 2	**(80uv)** 87 V		Pin 2 - pin 3	**(225uv)** 249 V	
Pin 1 - pin 3	**(300uv)** 337 V		Pin 3 - pin 4	**(240uv)** 240 V	
Pin 1 - pin 4	**(530uv)** 599 V		Pin 4 - pin 5	**(float)** FLOAT V	
Pin 1 - pin 5	**(float)** FLOAT V		Pin 5 - pin 6	**(float)** FLOAT V	
Pin 1 - pin 6	**(float)** FLOAT V				

Voltage tap Connector 2 (Redundant) (Fisher DEE104A06)

Pin 1 - pin 2	**(80uv)** 89 V		Pin 2 - pin 3	**(225uv)** 253 V	
Pin 1 - pin 3	**(300uv)** 342 V		Pin 3 - pin 4	**(240uv)** 246 V	
Pin 1 - pin 4	**(530uv)** 606 V		Pin 4 - pin 5	**(float)** FLOAT V	
Pin 1 - pin 5	**(float)** FLOAT V		Pin 5 - pin 6	**(float)** FLOAT V	
Pin 1 - pin 6	**(float)** FLOAT V				

3.2 Verify that between pin 5 and the coiled wire at the bottom of the lead has continuity:

Connector 1 (Primary) Pin 5 and end of the wire continuity is OK ☑ not OK ☐

Comments

Connector 2 (Redundant) Pin 5 and end of the wire continuity is OK ☑ not OK ☐

Comments

3.2.1 Using a small piece of fiberglass tape, mark the Primary and Redundant wires

3.3 Temperature sensor resistance measurements.

3.3.1 Two wire measurement on connector 3 (Fisher DEE104Z086):

Resistance between Pin 1	and pin 2	.61	Ω
Resistance between Pin 1	and pin 3	109.65	Ω
Resistance between Pin 1	and pin 4	109.64	Ω
Resistance between Pin 2	and pin 3	109.75	Ω

4. Initial Electrical Checkout

LEAD 33

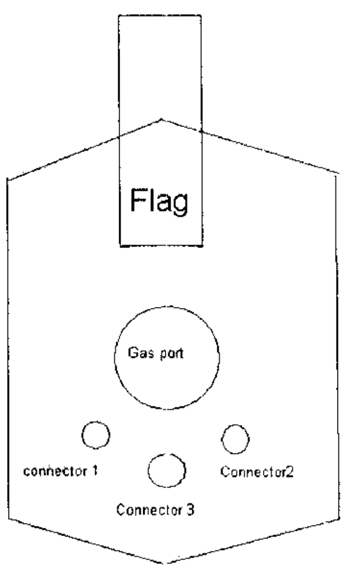
Resistance between Pin 2 and pin 4 109.62 Ω
Resistance between Pin 3 and pin 4 .60 Ω
Pins 1-4 resistance to lead ∞ Ω Pins 1-4 resistance to flange ∞ Ω

Resistance between Pin 5 and pin 6 .59 Ω
Resistance between Pin 5 and pin 7 109.54 Ω
Resistance between Pin 5 and pin 8 109.54 Ω
Resistance between Pin 6 and pin 7 109.54 Ω
Resistance between Pin 6 and pin 8 109.53 Ω
Resistance between Pin 7 and pin 8 .60 Ω
Pins 5-8 resistance to lead ∞ Ω Pins 5-8 resistance to flange ∞ Ω

Resistance between Pin 9 and pin 10 .48 Ω
Resistance between Pin 9 and pin 11 109.38 Ω
Resistance between Pin 9 and pin 12 109.38 Ω
Resistance between Pin 10 and pin 11 109.39 Ω
Resistance between Pin 10 and pin 12 109.39 Ω
Resistance between Pin 11 and pin 12 .49 Ω
Pins 9-12 resistance to lead ∞ Ω Pins 9-12 resistance to flange ∞ Ω

3.3.2 Using HP3458 DVM measure temperature sensor resistance with the four wire measurement technique:

Resistance of T1 109.02 Ω (I+ at pin 1, I- at pin 2, U+ at pin 3, U- at pin 4)
Resistance of T2 108.96 Ω (I+ at pin 5, I- at pin 6, U+ at pin 7, U- at pin 8)
Resistance of T3 108.91 Ω (I+ at pin 9, I- at pin 10, U+ at pin 11, U- at pin 12)



Looking from the top of the lead down where the LTS cable is located.
Connector 2= Redundant and Connector 1= Primary

FERMILAB
Technical Division

Stand 3 LHC-HTS Lead Testing: 5. Installation of the Current Leads

Lead Pair

Negative Lead: DFLX 33

Positive Lead: DFLX 34

Signed [signature] Date 7-17-03

1. Mechanical Integration of Current Leads in Test Facility

1.1 Using wedges, tilt the insert by 10° so that the power leads will be vertical when installed.
1.2 Clean sealing surfaces inside the chimneys with acetone and/or alcohol wipe.
1.3 Position the upper insulator in each chimney according to Figure 1.3.
1.4 Position the PEEK seal in each chimney according to Figure 1.3.
1.5 Position the lower insulator in each chimney according to Figure 1.3.

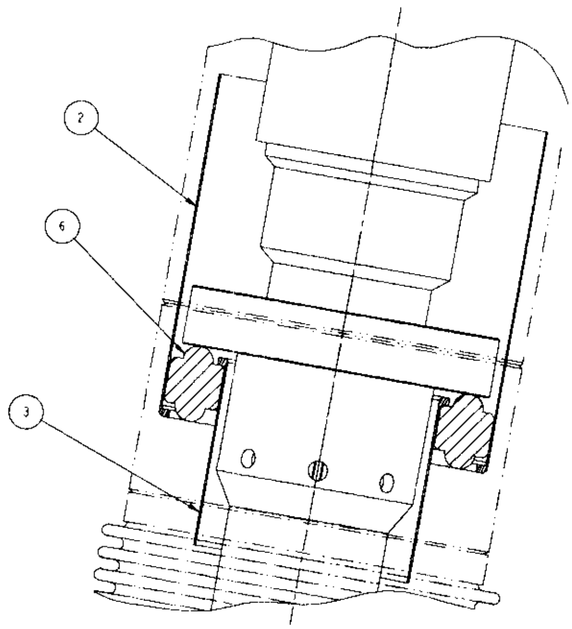


Figure 1.3 2 – Upper Insulator, 3 – Lower Insulator, 6 – PEEK Seal

1.6 Attach the lifting/insertion tool to the lead flag as shown in Figure 1.6 and remove the lead from the shipping container.

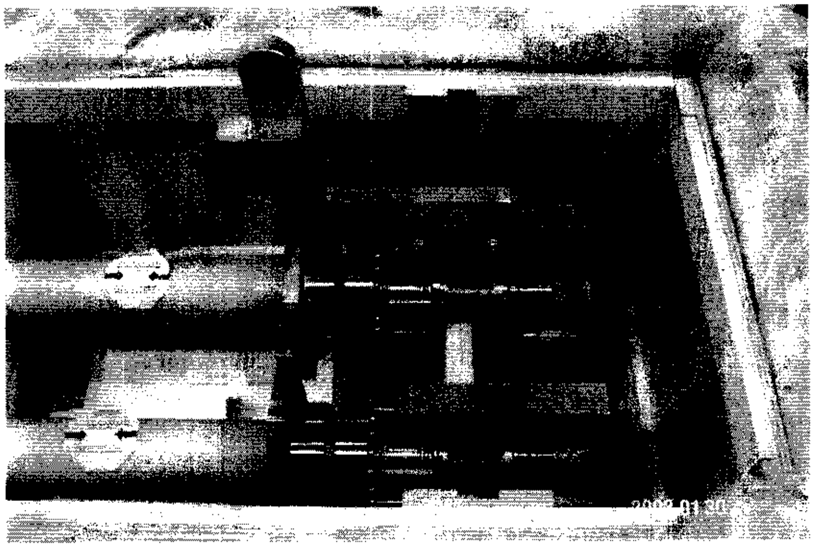


Figure 1.6 The lifting/insertion tool bolted to a power lead in preparation for removing it from the shipping container.

1.7 Remove the plastic plug from the 4-20 K gas inlet on the lead body.
1.8 Remove the protective covers from the lower and upper flanges.
1.9 With alcohol, clean the lower flange and the upper flange knife edge and sealing surface.
1.10 Prepare to install the power lead baffle by removing the short threaded rods to open the baffle.
1.11 Install the baffle on the lead with the pointed tips of the threaded rods pointing toward the bottom of the lead. An installed baffle is shown in Figure 1.11.

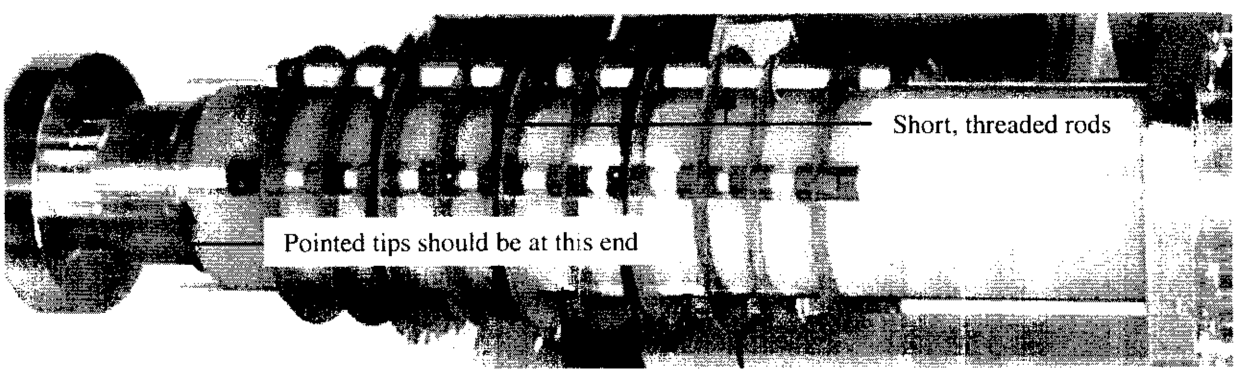


Figure 1.11 A baffle installed on a power lead.

1.12 Clamp the end support around the lower flange so that the handles will rest on the backs on the C-channels clamped to the steel table.
1.13 Set the lead in the C-channels on the steel table.
1.14 Clean the top plate Conflat flange knife edge and copper gasket. Install the gasket on the top plate Conflat flange.

1.15 Align the top plate rotatable Conflat flange to the orientation shown on Figure 1.15, where the leak check grooves on the flange align with the middle tensioning studs.

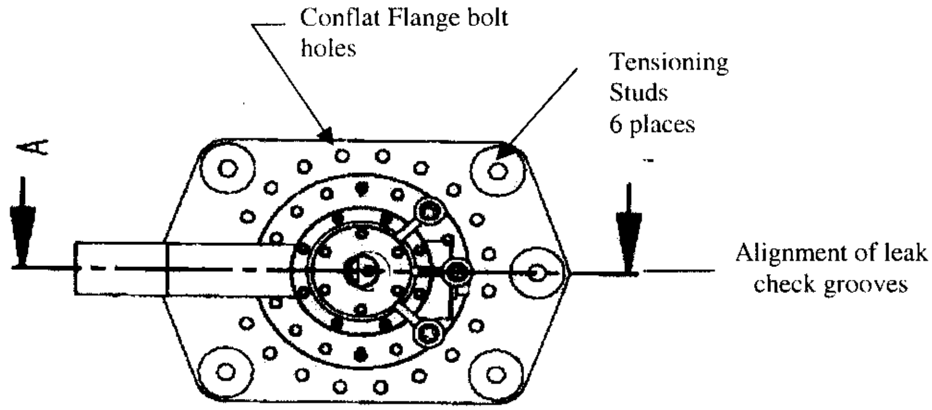


Figure 1.15 The 20-hole Conflat bolt pattern is bisected by center tensioning studs.

1.16 Back down the nuts on the tensioning studs.

1.17 Swing the lifting/insertion tool 180 degrees as shown in Figure 1.17 in preparation for lifting the power lead into the vertical position.

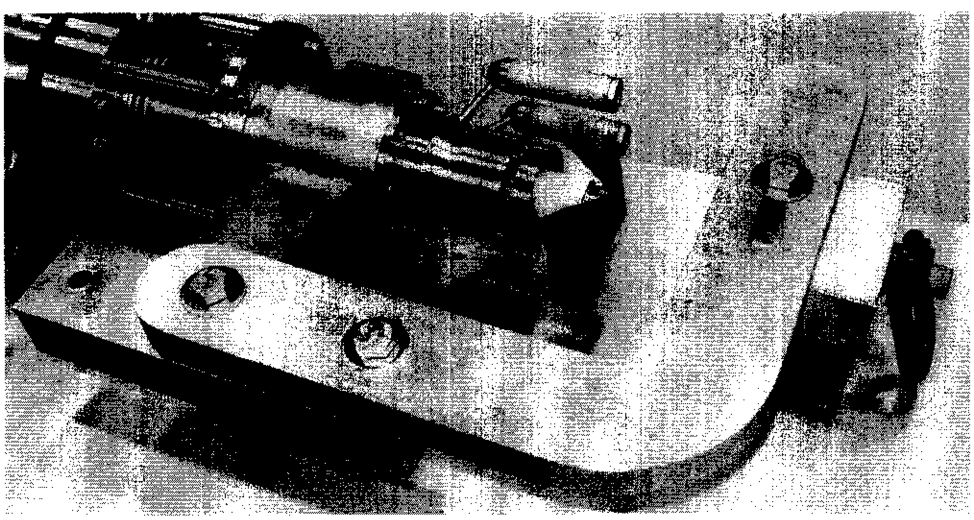


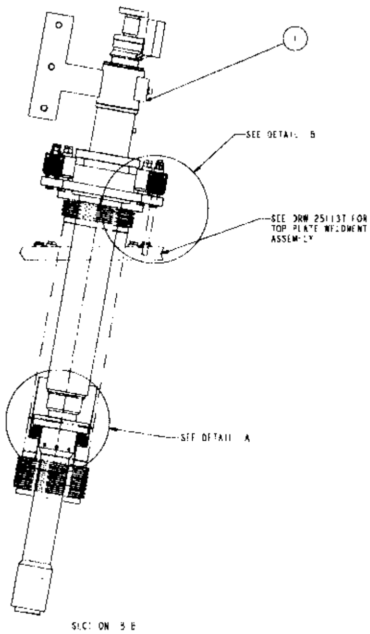
Figure 1.17 The lifting/insertion tool in position to lift the power lead into a vertical position.

1.18 Strapping the overhead crane to the lifting/insertion tool and manually guiding the lower end support, lift the lead and position it vertically while not allowing any loading on the bottom end of the lead.

1.19 Remove the lower end support.

1.20 Tie a weighted string to the LTS bus to help guide it through the chimney during installation.

1.21 Install the lead in the chimney per Figure 1.21a until the lower sealing flange bottoms out. The flag should be toward the bayonet connections on the insert. The negative lead is installed on the left hand side, and the positive lead is installed on the right hand side as shown in Figure 1.21b.



<u>Figure 1.21a</u> HTS Lead in Test Chimney. Note: CERN chimneys do not have bellows.

Negative Lead DFLX ___33___ Positive Lead DFLX ___34___

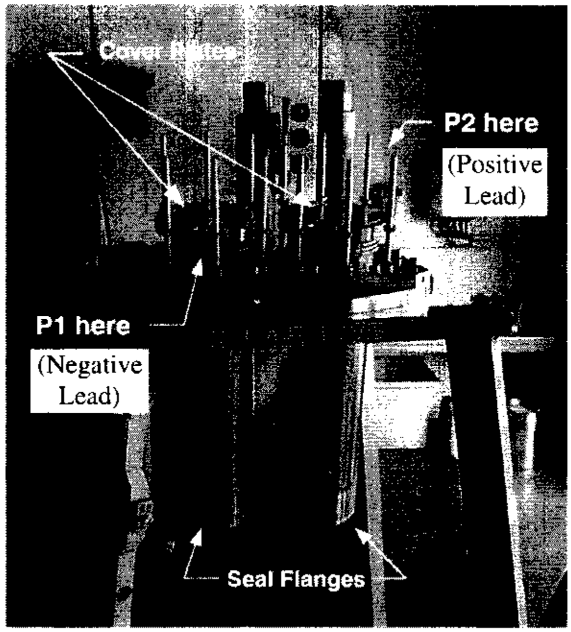


Figure 1.21b Locations of the negative and positive leads.

1.22 Raise the nuts on the tensioning studs to hold the lead in place, as shown in Figure 1.22.

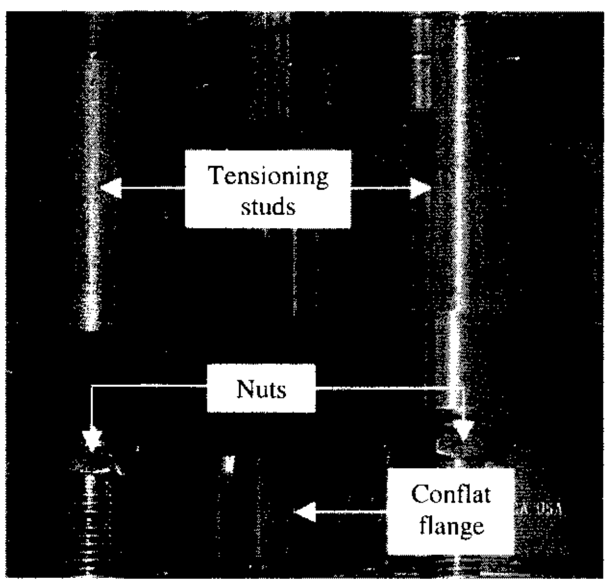


Figure 1.22 The positions of the tensioning studs, nuts, and top plate Conflat flange as the 20 Conflat bolts are tightened.

1.23 Center the lower end of the lead in the chimney using the centering shim blocks. The Teflon inner centering shim blocks are labeled with an 'I' and go between the power lead and the lower insulator. The Teflon outer centering shim blocks are labeled with an 'O' and go between the lower insulator and the chimney. The installed Teflon centering shim blocks are shown in Figure 1.23.

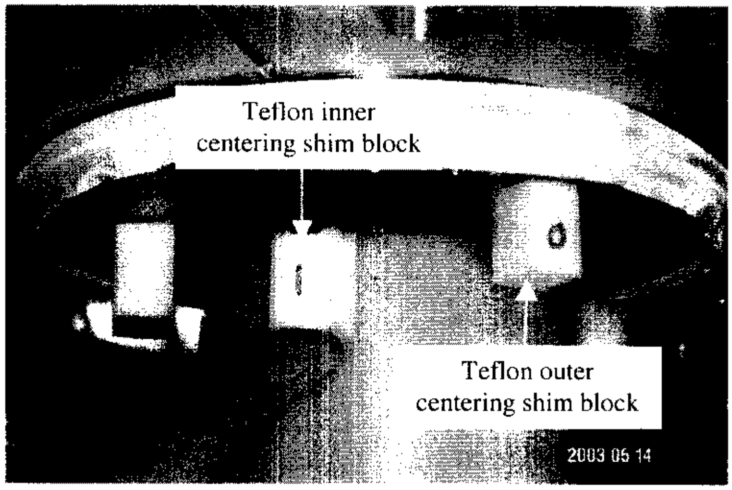


Figure 1.23 The installed Teflon centering shim blocks.

1.24 On the power lead flange, number the Conflat bolt holes 1 through 20 as indicated by Figure 1.25.

1.25 If there is a gap between the top plate Conflat flange and the Pirelli flange, pull the bellows up to close the gap using bolts 1 through 4.

1.26 Use a 5/16 12-point socket to tighten the 20 Conflat bolts. The tightening must be made gradually in ¼ turn increments to a final torque of 15 ft-lbf (180 in-lbf). The tightening sequence is given by Fig. 1.26.

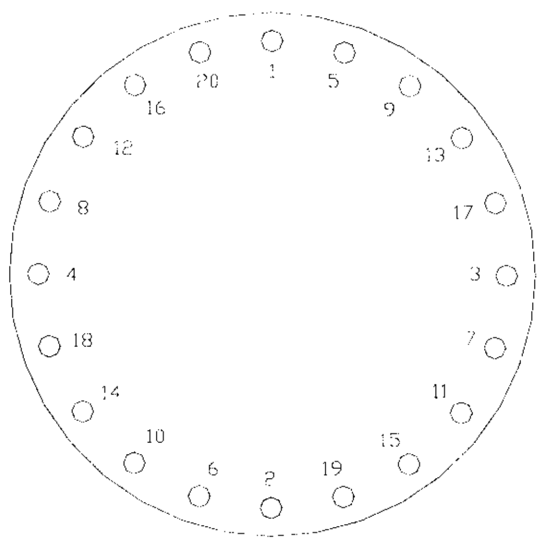


Figure 1.26 Tightening sequence for the 20 Conflat bolts.

1.27 Unbolt the lifting/insertion tool from the installed power lead.

1.28 Install Belleville Washer Assemblies on each tensioning stud per Figures 1.28a and 1.28b. A spherical washer must be placed below the Belleville washer holder on each stud. In the figures: Items 11 (10 each) are Belleville Washers, arranged as shown; Items 6 (2 each) are flat washers; Items 4 and 5 are the Belleville Washer Holder; Item 10 are Spherical Washers for above and below the washer holder; Item 9 is a loading nut; and Item 8 is a jam nut.

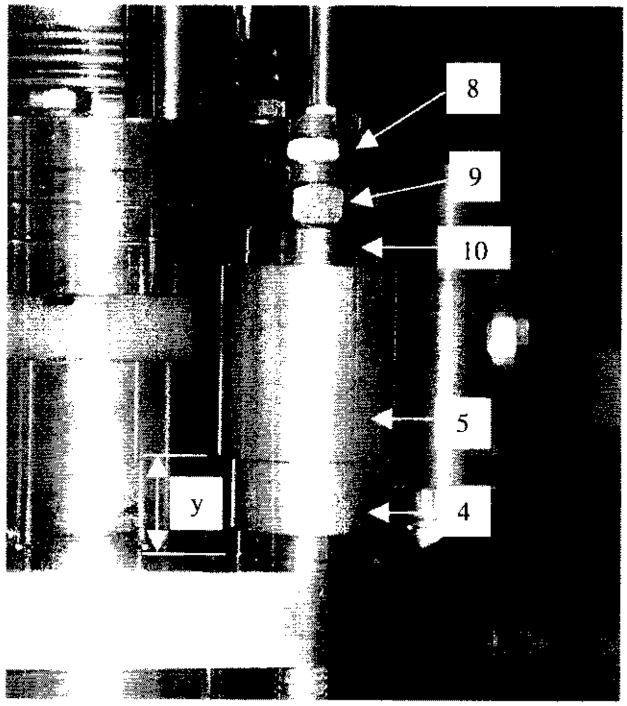


Figure 1.28a An installed Belleville Washer Assembly.

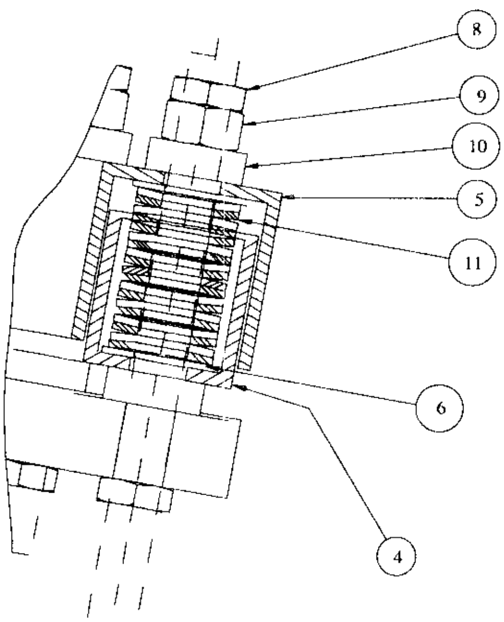


Figure 1.28b An installed Belleville Washer Assembly.

1.29 Tighten the 6 Belleville Washer Assemblies to apply load to the PEEK seal.

1.29.1 Washers for Lead **DFLX** 33

Negative Lead DFLX 33 Positive Lead DFLX 34

1.29.1.1 Ensure that the tensioning rod nuts used in 1.22 have a gap of about 5 mm below the lead flange.

1.29.1.2 Tighten the 6 loading nuts finger-tight. With adjustable parallels, measure and record the gap "y" indicated in Figure 1.28a between Item 5 and the current lead top flange at the 6 locations specified in Figure 1.29.1.5. Units are mm.

A 24.20 B 23.64 C 23.73 D 23.85 E 23.98 F 23.54 ✓

1.29.1.3 For each of the six studs: remove the adjustable parallel, adjust it for 1.8 mm of compression, and return the adjustable parallel into position under the Belleville washer holder. Record the adjusted heights of the adjustable parallels. Units are mm.

A 22.4 B 21.84 C 21.93 D 22.05 E 22.18 F 21.74

1.29.1.4 Using the sequence A through F in Figure 1.29.1.5, tighten the loading nuts ¼ turn until the total compression is 1.8 mm at each of the six locations. As each loading nut is tightened ¼ turn, check off the appropriate line.

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ____ B ✓ C ✓ D ✓ E ✓ F ✓

Negative Lead DFLX 33 Positive Lead DFLX 34

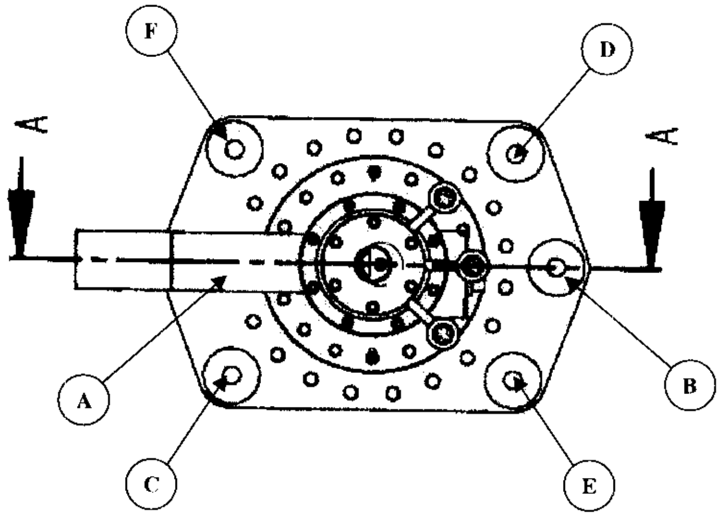


Figure 1.29.1.5 The specified sequence for tightening the Belleville Washer Assemblies.

1.29.1.5 Record the final measured gaps 'y' in Figure 1.28a. Units are mm.

A 22.48 B 21.72 C 21.99 D 22.22 E 21.72 F 21.78

1.29.1.6 Remove the Teflon centering shim blocks from the installed power lead.

1.29.2 Washers for Lead **DFLX** 34

1.29.2.1 Ensure that the nuts used in 1.22 have a gap of about 5 mm below the lead flange.

1.29.2.2 Tighten the 6 loading nuts finger-tight. With adjustable parallels, measure and record the gap "y" indicated in Figure 1.28a between Item 5 and the current lead top flange at the 6 locations specified in Figure 1.29.1.5. Units are mm.

A 23.92 B 23.39 C 25.71 D 23.68 E 24.66 F 24.18

1.29.2.3 For each of the six studs: remove the adjustable parallel, adjust it for 1.8 mm of compression, and return the adjustable parallel into position under the Belleville washer holder. Record the adjusted heights of the adjustable parallels. Units are mm.

A 22.12 B 21.54 C 21.91 D 21.88 E 22.86 F 22.38

1.29.2.4 Using the sequence A through F in Figure 1.29.1.5, tighten the loading nuts ¼ turn until the total compression is 1.8 mm at each of the six locations. As each of the loading nuts is turned ¼ turns, check off the appropriate line.

A ✓✓✓ B ✓✓✓ C ✓✓✓ D ✓✓✓ E ✓✓✓ F ✓✓✓

A ✓ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ____ E ✓ F ✓

A ✓ B ✓ C ✓ D ____ E ✓ F ✓

A ✓ B ✓ C ✓ D ____ E ✓ F ✓

A ____ B ✓ C ✓ D ✓ E ✓ F ✓

A ✓ B ✓ C ✓ D ____ E ✓ F ____

A ✓ B ✓ C ✓ D ____ E ✓ F ____

A ____ B ____ C ✓ D ____ E ____ F ____

1.29.2.5 Record the final measured gaps 'y' in Figure 1.28a. Units are mm.

A 22.13 / [illegible] B 21.40 / 21.57 C 21.84 / 21.81 D 23.16 / 21.82 E 22.64 / 22.71 F 22.49 / 22.14

1.29.2.6 Remove the Teflon centering shim blocks from the installed power lead.

1.30 On both power leads, tighten down the jam nuts to secure the loading nuts on the installed Belleville Washer Assemblies.

1.31 Tighten the nuts on the underside of the current lead top plate against the plate to provide stability during transportation.

2. Pressure Test

2.1 Follow the procedure specified in the document entitled, "7500 A HTS Power Leads for the LHC DFBX: 6. Pressure Test Procedure."

3. Leak Check

3.1 Follow the procedure specified in the document entitled, "7500 A HTS Power Leads for the LHC DFBX: 7. Leak Check Procedure."

4. Electrical Integration of Current Leads in Test Facility

4.1 Attach the G-10 clamshell clamp at the bottoms of the power leads, and install the clamp support.

4.2 Make connection to LTS pigtails. The joint is a mechanical connection with a stainless steel clamp (supplied by LBNL) and indium foil between the cables to ensure good electrical contact. Figure 4.1a shows a rendition of the installed power leads. Figure 4.1b shows the G-10 clamshell clamp, the clamp support, and the mechanical clamp.

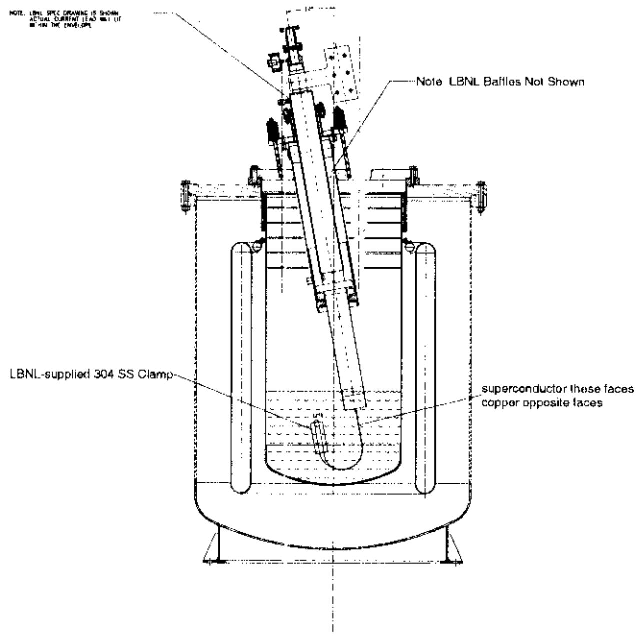


Figure 4.1a Side View of Lead in Cryostat with the LTS cables connected.

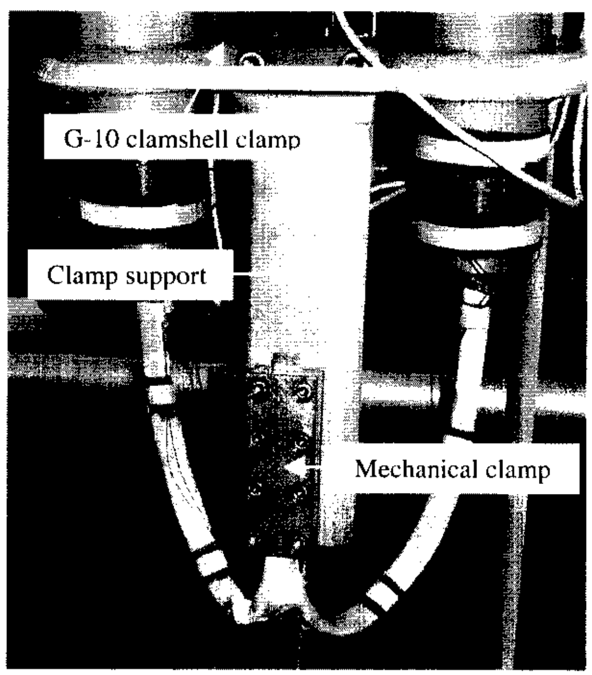


Figure 4.1b Electrical integration of the LTS sections.

4.3 Clamp a piece of bus wire and a little indium to the LTS cable. Solder the two V5 voltage tap wires to the bus wire. Wind excess voltage tap wire around the bottom of the lead, securing it with Kapton and glass tape.

4.4 Insulate the superconducting cable with Kapton and glass tape.

4.5 Install He space temperature sensors and LHe liquid level probes.

4.6 Install the bottom fill tube.

4.7 Bolt the heaters to each power lead. Use grease at the interface to improve the thermal contact between the heater and power lead.

4.8 Measure and record dimensions required for the insert map.

Negative Lead DFLX 33 Positive Lead DFLX 34

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7500 A HTS Power Leads for the LHC DFBX: 5a. Preliminary Leak Check Procedure

Lead Number: DFLX33

Signed C. E. Hess Jr. Date 07/02/03

1. **Preparation for Leak Checking**
   - **1.1** Put the power lead on the steel table, with the power lead lower flange resting in the end support clamp.
   - **1.2** Plug the 4-20 K inlet.
   - **1.3** Attach an adapter to the top of the power lead so that a leak detector can be connected.

2. **Leak Check-Lead Number** DFLX-33
   - **2.1** Pump out the power lead with the leak detector.
   - **2.2** Record the baseline reading from the leak detector.

   Baseline: $58_D \times 5_S$

   - **2.3** Spray all joints with He and watch for a signal from the leak detector
   - **2.4** Record the maximum leak detector reading.

   Maximum reading: $58_D \times 5_S$ = 7.3 e^{-8} atm cc/sec

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7500 A HTS Power Leads for the LHC DFBX: 6. Pressure Test Procedure

Lead Pair

Negative Lead: DFLX33

Positive Lead: DFLX34

Signed [signature] Date 7-17-03

1. **Preparation for Pressurization**
   - **1.1** Install the bayonet plug into the 4-20 K supply bayonet on the top plate. Tie it down.
   - **1.2** On the 4-20 K female bayonet vacuum jacket, cap off one of the 1/4 inch compression fittings. Connect the test gauge and associated tubing to the second 1/4 inch compression fitting.
   - **1.3** Install Conflat blankoffs on the vents of the installed power leads.
   - **1.4** Put the cover cans over each lead vent and tie them down.
   - **1.5** Connect a nitrogen bottle to the pressure test tubing.

2. **Pressurization**
   - **2.1** Pressurize the 4-20 K circuit to 65 psia (50 psig) and record the initial pressure from the test gauge.

     RR

     Initial pressure: 64.8 psia

   - **2.2** Wait five minutes and record the final pressure from the test gauge.

     RR

     Final pressure: 64.8 psia

3. **Release of Pressure**
   - **3.1** Isolate the nitrogen bottle.
   - **3.2** Release the pressure by opening the hand valve on the pressure test tubing.
   - **3.3** Disconnect the pressure test tubing from the top plate/insert.

Negative Lead DFLX 33 Positive Lead DFLX 34

FERMILAB
Technical Division

7500 A HTS Power Leads for the LHC DFBX:
7. Leak Check Procedure

Lead Pair

Negative Lead: DFLX33

Positive Lead: DFLX34

Signed C.E. [signature] Date 07.23.03

1. **Preparation for Leak Checking**
   - **1.1** Cap/plug the two 1/4 inch compression fittings on the 4-20 K female bayonet vacuum jacket.
   - **1.2** Remove the Conflat blankoff from one of the lead vents and install the modified Conflat with a vacuum pumpout.
   - **1.3** Attach a leak detector to the vacuum pumpout installed on the top of one of the power leads.

2. **Leak Check**
   - **2.1** Pump out the 4-20 K circuit with the leak detector.
   - **2.2** Record the baseline reading from the leak detector.

63 Division X 50 scale Baseline: 7.37e-7 atm. cc sec.

   - **2.3** Spray all joints with He and watch for a signal from the leak detector
   - **2.4** Record the maximum leak detector reading.

63 Division X 50 scale Maximum reading: 7.37e-7 atm. cc. sec.

Negative Lead DFLX 33 Positive Lead DFLX 34

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. 1 (SF) Date:January 31, 2003 Page 1 of 1 Author: Fred Lewis
	9. Room Temperature Electrical Checkout	

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

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Performed by Dan W, Fred L (Name typed) Dan Waters (Signature)

Date & time 7/23/03

Pos. Power Lead 7500 A DFLX 34 and Neg. Power Lead 7500 A DFLX 33

When checkout is complete, make sure you place the original and a copy of this document in the Traveler Binder.

Before beginning checkout, be sure that all 4-pin hypertronic connectors in dewar have been connected and taped up with fiberglass tape. Also install positive and negative lead heaters. Be sure to put thermal compound on back of heaters before attaching.

3.1 Voltage segment and drop measurement. Connect Kepco power supply cable to the leads. On stand 4, be sure that power supply box is switched to stand 3 and HFU kepco. Under stand 4 platform, connect stand 3 trim cable to shunt current monitor. Turn on kepco and set for 10 amps. Set up function generator for square wave. You should see current go from +10A to −10A. Frequency should be set at .01 (approx. 100 seconds). Check the cryo computer numerical display for trim to verify approx. 10A on leads. Record the applied current 10 A

Connect both primary and redundant vtap cables to positive and negative lead. Go to the back of vtap distribution box and disconnect both primary and redundant vtap cables for the positive and negative lead. Using a breakout box and these cables measure the voltages between the following pins:
Use HP3458 DVM, set it to 40-line cycle integration time.

Positive Lead

Voltage tap Connector 1 (Primary) (Fisher DEE104A06)

Pin 1 - pin 2 **(160uv)** 145u V   Pin 2 - pin 3 **(450uv)** 425u V
Pin 1 - pin 3 **(610uv)** 563u V   Pin 3 - pin 4 **(480uv)** 451u V
Pin 1 - pin 4 **(1.1mv)** 1.0m V   Pin 4 - pin 5 **(3.5mv)** 3.3m V
Pin 1 - pin 5 **(4.7mv)** 4.3m V   Pin 5 - pin 6 **(float)** – V
Pin 1 - pin 6 **(float)** – V

Performed by____
(Name typed) (Signature)

Date & time ____

Pos. Power Lead 7500 A DFLX 34 and Neg. Power Lead 7500 A DFLX 33

Voltage tap Connector 2 (Redundant) (Fisher DEE104A06)

Pin 1 - pin 2 **(160uv)** 147 u V Pin 2 - pin 3 **(450uv)** 419 u V
Pin 1 - pin 3 **(610uv)** 569 u V Pin 3 - pin 4 **(480uv)** 450 u V
Pin 1 - pin 4 **(1.1mv)** 1.0 m V Pin 4 - pin 5 **(3.5mv)** 3.3 m V
Pin 1 - pin 5 **(4.7mv)** 4.3 m V Pin 5 - pin 6 **(float)** — V
Pin 1 - pin 6 **(float)** — V

Negative Lead

Voltage tap Connector 2 (Primary) (Fisher DEE104A06)

Pin 1 - pin 2 **(-160uv)** -150 u V Pin 2 - pin 3 **(-450uv)** -427 m V
Pin 1 - pin 3 **(-600uv)** -574 u V Pin 3 - pin 4 **(-480uv)** -448 u V
Pin 1 - pin 4 **(-1.1mv)** -1.0 m V Pin 4 - pin 5 **(-3.5mv)** -3.3 m V
Pin 1 - pin 5 **(-4.7mv)** -4.3 m V Pin 5 - pin 6 **(float)** — V
Pin 1 - pin 6 **(float)** — V

Voltage tap Connector 2 (Redundant) (Fisher DEE104A06)

Pin 1 - pin 2 **(-160uv)** -150 u V Pin 2 - pin 3 **(-450uv)** -428 u V
Pin 1 - pin 3 **(-600uv)** -576 u V Pin 3 - pin 4 **(-480uv)** -454 u V
Pin 1 - pin 4 **(-1.1mv)** -1.0 m V Pin 4 - pin 5 **(-3.5mv)** -3.3 m V
Pin 1 - pin 5 **(-4.7mv)** -4.3 m V Pin 5 - pin 6 **(float)** — V
Pin 1 - pin 6 **(float)** — V

3.2 Using 2 Vtap cables: Connection 1-one vtap cable from the primary of each lead
Connection 2- one vtap cable from the redundant of each lead

Connection1 (Primary)

Positive Lead Pin 1 - Negative Lead pin 5 **(3.7mv)** 3.1 m V
Positive Lead Pin 1 - Negative Lead pin 4 **(7.3mv)** 6.4 m V
Positive Lead Pin 1 - Negative Lead pin 3 **(7.7mv)** 6.9 m V
Positive Lead Pin 1 - Negative Lead pin 2 **(8.2mv)** 7.3 m V
Positive Lead Pin 1 - Negative Lead pin 1 **(8.3mv)** 7.4 m V

Connection 2 (Redundant)

Positive Lead Pin 1 - Negative Lead pin 5 **(3.7mv)** 3.1 m V
Positive Lead Pin 1 - Negative Lead pin 4 **(7.3mv)** 6.4 m V
Positive Lead Pin 1 - Negative Lead pin 3 **(7.7mv)** 6.9 m V
Positive Lead Pin 1 - Negative Lead pin 2 **(8.2mv)** 7.3 m V
Positive Lead Pin 1 - Negative Lead pin 1 **(8.3mv)** 7.4 m V

When voltage measurements are complete, turn off kepco power supply and disconnect kepco power cable on positive and negative lead.

9. Room Temperature Electrical Checkout

Performed by ______________________________
(Name typed) (Signature)

Date & time ______________________________

Pos. Power Lead 7500 A DFLX 34 and Neg. Power Lead 7500 A DFLX 33

3.3 Temperature sensor resistance measurements. Using test cable, connect to connector 3 (lead rtd's) of leads. Lead rtd's are (511-3, 512-3, 509-3A, 509-3B, 510-3A, 510-3B).

3.3.1 Two wire measurement on connector 3 of Positive Lead (Fisher DEE104Z086):

Resistance between Pin 1 and pin 2 **(.800)** 1.01 Ω
Resistance between Pin 1 and pin 3 **(109)** 110 Ω
Resistance between Pin 1 and pin 4 **(109)** 110 Ω
Resistance between Pin 2 and pin 3 **(109)** 110 Ω
Resistance between Pin 2 and pin 4 **(109)** 110 Ω
Resistance between Pin 3 and pin 4 **(.800)** .974 Ω
Pins 1-4 resistance to lead ∞ Ω Pins 1-4 resistance to flange ∞ Ω

Resistance between Pin 5 and pin 6 **(.800)** .977 Ω
Resistance between Pin 5 and pin 7 **(109)** 110 Ω
Resistance between Pin 5 and pin 8 **(109)** 110 Ω
Resistance between Pin 6 and pin 7 **(109)** 110 Ω
Resistance between Pin 6 and pin 8 **(109)** 110 Ω
Resistance between Pin 7 and pin 8 **(.800)** .971 Ω
Pins 5-8 resistance to lead ∞ Ω Pins 5-8 resistance to flange ∞ Ω

Resistance between Pin 9 and pin 10 **(.800)** .905 Ω
Resistance between Pin 9 and pin 11 **(109)** 110 Ω
Resistance between Pin 9 and pin 12 **(109)** 110 Ω
Resistance between Pin 10 and pin 11 **(109)** 110 Ω
Resistance between Pin 10 and pin 12 **(109)** 110 Ω
Resistance between Pin 11 and pin 12 **(.800)** .878 Ω
Pins 9-12 resistance to lead ∞ Ω Pins 9-12 resistance to flange ∞ Ω

3.3.2 Using HP3458 DVM measure temperature sensor resistance with the four wire measurement technique:

Resistance of T1 107.9 **Ω(108.5)**(I+ at pin 1,U+ at pin 2,I- at pin 3,U- at pin 4)
Resistance of T2 109.9 **Ω(108.5)** (I+ at pin 5, U+ at pin 6, I- at pin 7, U- at pin 8)
Resistance of T3 109.8 **Ω(108.5)**(I+ at pin 9,U+ at pin 10,I- at pin 11,U- at pin 12)

DFLX 34 DFLX 33

Performed by____
(Name typed) (Signature)

Date & time ____

Pos. Power Lead 7500 A DFLX 34 and Neg. Power Lead 7500 A DFLX 33

3.3.3 Two wire measurement on connector 3 of Negative Lead (Fisher DEE104Z086):

Resistance between Pin 1 and pin 2 **(.800)** 1.04 Ω
Resistance between Pin 1 and pin 3 **(109)** 110 Ω
Resistance between Pin 1 and pin 4 **(109)** 110 Ω
Resistance between Pin 2 and pin 3 **(109)** 110 Ω
Resistance between Pin 2 and pin 4 **(109)** 110 Ω
Resistance between Pin 3 and pin 4 **(.800)** .973 Ω
Pins 1-4 resistance to lead ∞ Ω Pins 1-4 resistance to flange ∞ Ω

Resistance between Pin 5 and pin 6 **(.800)** .984 Ω
Resistance between Pin 5 and pin 7 **(109)** 110 Ω
Resistance between Pin 5 and pin 8 **(109)** 110 Ω
Resistance between Pin 6 and pin 7 **(109)** 110 Ω
Resistance between Pin 6 and pin 8 **(109)** 110 Ω
Resistance between Pin 7 and pin 8 **(.800)** .980 Ω
Pins 5-8 resistance to lead ∞ Ω Pins 5-8 resistance to flange ∞ Ω

Resistance between Pin 9 and pin 10 **(.800)** .908 Ω
Resistance between Pin 9 and pin 11 **(109)** 110 Ω
Resistance between Pin 9 and pin 12 **(109)** 110 Ω
Resistance between Pin 10 and pin 11 **(109)** 110 Ω
Resistance between Pin 10 and pin 12 **(109)** 110 Ω
Resistance between Pin 11 and pin 12 **(.800)** .881 Ω
Pins 9-12 resistance to lead ∞ Ω Pins 9-12 resistance to flange ∞ Ω

3.3.4 Using HP3458 DVM measure temperature sensor resistance with the four wire measurement technique:

Resistance of T1 109.9 Ω**(108.5)**(I+ at pin 1,U+ at pin 2,I- at pin 3,U- at pin 4)
Resistance of T2 109.8 Ω **(108.5)**(I+ at pin 5, U+ at pin 6, I- at pin 7, U- at pin 8)
Resistance of T3 104.7 Ω**(108.5)**(I+ at pin 9,U+ at pin 10,I- at pin 11,U- at pin 12)

DFLX 34 DFLX 33

Performed by____
(Name typed) (Signature)

Date & time ____

Pos. Power Lead 7500 A DFLX 34 and Neg. Power Lead 7500 A DFLX 33

3.4 Check remaining rtd's. This includes rtd's in the dewar (530-3,531-3,532-3,534-3, 535-3), in the leads (507-3A, 507-3B), for the N2 shield (594-3), and the outlet HE for each lead (513-3,514-3). Connect cables for three 19-pin top plate connectors labeled "dewar 0, dewar 1, and dewar inlet HE te/ll". Also connect 4-pin cables for N2 shield and outlet HE (one for each lead). All of these can be read out on the cryo computer. This cannot be done until Mike T has rebooted the system. Once into the system, you need to switch to a computer on the main network. The command for this is "ssh" (for example, ssh mdtf34). To open the GUI and choose readout values type "numdisp –n mtfvx27&". The selected rtd's should read room temperature that is approximately 295 K. The cables for rtd's in the leads can be connected (511-3,512-3,509-3A, 509-3B, 510-3A, 510-3B) and can be read out on the mtfops computer and should also read approximately 295K. Any problems list in space provided below:

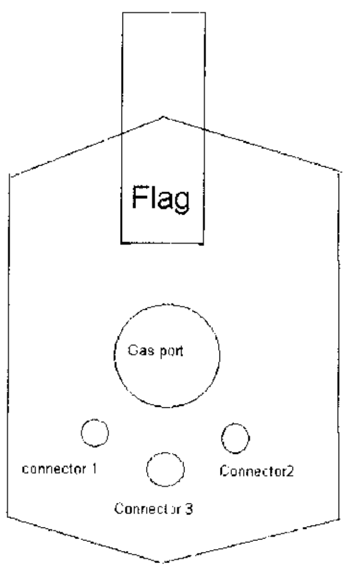
3.5 Check both liquid levels (12" and 30"). The 12" liquid level is connected to pins 9-12 of "dewar inlet HE te/ll" cable. Connect 4-pin cable to top plate for 30" probe. Disconnect J1 at the back of each liquid level meter and do a 4-wire resistance measurement on each probe. The resistance should read about 165 Ω (for 12") and 412 Ω (for 30"). Wires come out to pins 1(red), 7(black), 8(blue), and 6(yellow) on J1 connector. Do following measurements for each probe:

1. 1(red) to 8(blue)	should be approx. 5 Ω
2. 8(blue) to 6(yellow)	should be approx. (13.75 X active length of probe) 165 Ω for 12" and 412.5 Ω for 30"
3. 6(yellow) to 7(black)	should be something less than 5 Ω
4. 1(red) to 7(black)	should approximately equal resistance from #2 + #1

9. Room Temperature Electrical Checkout

4-Wire resistance measurement:
12" Dewar 164 Ω 30" Dewar 404 Ω 30" Phase sep. 404 Ω

	12" Dewar	30"Dewar	30" Phase sep
1. 1(red) to 8(blue)	6.3 Ω	6.2 Ω	7.1 Ω
2. 8(blue) to 6(yellow)	166 Ω	405 Ω	406 Ω
3. 6(yellow) to 7(black)	2.5 Ω	1.2 Ω	2.1 Ω
4. 1(red) to 7(black)	171 Ω	410 Ω	411 Ω



Looking from the top of the lead down where the LTS cable is located.
Connector 2= Redundant, Connector 1= Primary and Connector 3= RTD.

NOTE: After checkout is complete, be sure to set up kepco with function generator for +/- 10 amps and then turn off. Cryo techs will turn on when they begin cool down.

DFLX 34 DFLX 33

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Technical Division

7500 A HTS Power Leads for the LHC DFBX: 10. Installation of the Top Plate

Lead Pair

Negative Lead: DFLX 33

Positive Lead: DFLX34

Signed [signature] **Date** 7-23-03

√ 1. Install all bolts to fasten the top plate to the dewar extension.

√ 2. Loosen the tensioning rod nuts on the undersides of the lead plates at least 0.5 mm below the lead plate.

√ 3. Install the transfer lines for maintaining the test dewar liquid level.

√ 4. Install the transfer lines supplying the 4-20 K circuit.

√ 5. Install the test dewar flexible vent line.

√ 6. Install a power lead vent stack on each power lead, keeping in mind the orientation of the vent line.

√ 7. Connect the vent lines (thermally insulated, non-conductive hoses) to the power lead vent stacks.

√ 8. Connect the lines labeled "+ LD PDT –" and "- LD PDT –" to the positive and negative lead vent stacks, respectively. These lines connect to the low side of the differential pressure transducers.

√ 9. Connect the lines labeled "+ LD PDT +" and "- LD PDT +" at the 4-20 K female bayonet vacuum jacket. These lines connect to the high side of the differential pressure transducers.

√ 10. Connect the power leads' warm gas supply line to the 4-20 K transfer line.

√ 11. Connect one end of the bypass line at the phase separator and the other end at the vent piping.

Negative Lead DFLX 33 Positive Lead DFLX 34

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date: March 5,2003 Page 1 of 1 Author: Dan Eddy
	10.1 Warm Temp Hi-pot In Gasous He Environment	

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

.

Performed by Dan W, Fred L (Name typed) [signature] (Signature)

Date & time 7/24/03

Pos. Power Lead 7500 A DFLX 34 and Neg. Power Lead 7500 A DFLX 33

This hi-pot should be performed after dewar has been filled with gaseous helium. <u>Notify the Cryo Operator before you disconnect cables</u>. When checkout is complete, make sure you place the original and a copy of this document in the Traveler Binders.

3.1 Short all of the temperature sensors together using the special RTD high pot cable. High pot each set of temperature sensor to 300v with respect to the Lead (ground).

Record breakdown voltage (if any) – V.
Record current .01 u A

3.2 Hi-pot the leads in a gaseous He environment to 1500V (1.3 Bar) using a Droege HV power supply. Connect the positive clip to one lead and the negative clip to ground. Also, short all of the temperature sensors together using the special RTD high pot cable. Connect the ring terminal from each connector to the flag of each lead. **Be sure to disconnect all voltage tap cables on both leads and the power connections from Kepco power supply.**

Record breakdown voltage (if any) – V.
Record current .02 A.
Record approximate temp. 295 K.
Record approximate dewar pressure 3.5 PSIG.

FERMILAB
Technical Division

7500 A HTS Power Leads for the LHC DFBX: 12. Cooldown Checklist

Lead Pair

Negative Lead: DFLX 33

Positive Lead: DFLX 34

Signed (Roger Rabehl) Date 7/24/03

✓ 1. ±5 A applied to the current leads during cooldown.

✓ 2. DAQ system is operational (temperature sensor readouts in the test dewar helium space are updating).

✓ 3. Test dewar and power leads cooled down as per the cooldown procedure "7500 A HTS Power Leads for the LHC DFBX: 12b. Cryogenic Operating Procedure".

Negative Lead DFLX 33 Positive Lead DFLX 34

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

Performed by Dan W, Fred L (Name typed) Dan Wilson (Signature)

Date & time 7/24/03

Pos. Power Lead 7500 A DFLX 34 and Neg. Power Lead 7500 A DFLX 33

This hi-pot should be performed after dewar has been filled with liquid helium. Notify the Cryo Operator before you disconnect cables. When checkout is complete, make sure you place the original and a copy of this document in the Traveler Binders.

3.1 Short all of the temperature sensors together using the special RTD high pot cable. High pot each set of temperature sensor to 300v with respect to the Lead (ground).

Record breakdown voltage (if any) – V.
Record current .01 u A

3.2 Hi-pot the leads in a cold (4.5K) He environment to 1500V (1.3 Bar) using a Droege HV power supply. Connect the positive clip to one lead and the negative clip to ground. Also, short all of the temperature sensors together using the special RTD high pot cable. Connect the ring terminal from each connector to the flag of each lead. **Be sure to disconnect the redundant voltage taps on both leads and the power connections from Kepco power supply.**

Record breakdown voltage (if any) – V.
Record current .3 u A.
Record approximate temp. 4.2K K.
Record approximate dewar pressure 3 PSIG.

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Technical Division

7500 A HTS Power Leads for the LHC DFBX: 14. Connect the Leads to the Power Supply & Configure

Lead Pair

Negative Lead: DFLX 33

Positive Lead: DFLX34

Signed Roger Rabehl Date 7/24/03

1. **Power Supply Changes**

✓ **1.1** On the FIX32 HMTF Power Interlock screen, switch the selector switch to the Stand 3 position.

✓ **1.2** Switch warning lights to the "Stand 3" position.

✓ **1.3** Adjust the power supply time constant by setting the resistance to 500 μΩ.

✓ **1.4** Adjust the power supply time constant by setting the inductance to 0.5 mH.

✓ **1.5** Adjust the dump resistance to 30 mΩ.

2. **Bus Connection Changes – Stand 3 Side**

✓ **2.1** Perform MTF-ELEC-07 (VMTF/ST4/ST3) LOTO procedure for all handling of flexible bus work.

✓ **2.2** Mate the Stand 3 hard bus with the Stand 4 flexible bus on the Stand 4 platform. Verify the polarity is correct.

✓ **2.3** Disconnect trim current supply leads.

✓ **2.4** Connect the flex leads and chill blocks to the power lead flags.

✓ **2.5** Attach voltage taps VFF-A and VFF-B at the negative and positive flex lead flags, respectively, and voltage VLF-A and VLF-B at the negative and positive power lead flags, respectively. These taps will allow the voltage drop across the flex lead/chill block joint and chill block/power lead joint to be measured.

✓ **2.6** Using glass tape, attach the Kapton-wrapped platinum temperature sensors TE515-3 and TE516-3 to the positive and negative lead flags, respectively.

✓ **2.7** Wrap the power lead flags with rubber insulation for personnel safety.

✓ **2.8** Install the plexiglass enclosure around the power leads for personnel safety.

3. **Bus Connection Changes – VMTF End**

✓ **3.1** Remove the short VMTF flex leads from the 30 kA bus work.

✓ **3.2** Install flex leads from the Stand 4 bus to the 30 kA bus work.

Negative lead DFLX 33 Positive lead DFLX 34

FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date:May 13, 2003 Page 1 of 1 Author: Fred Lewis
	15. OD circuit checkout	

Performed by Dan W, Fred L (name typed) Dan Walton (signature)

Date & time 7/24/03

Power Lead 7500 A DFLX 34

When checkout is complete, make sure you place this document in the Traveler Binders

(1) Connect HTS LEAD V-TAP Breakout box to 6 pin Primary V-TAP connector for Lead #1 and Lead #2.

(2) Connect HTS LEAD V-TAP Breakout box to 8 pin Lead test cable connector for Lead #1 and Lead #2.

(3) Connect standard breakout box to one of the 8 pin Lead test cables on the Stand-4 platform.

(4) Use a voltage source to inject a signal into the appropriate pins as per the Threshold Setup spreadsheet and set the threshold. Do the same for the other lead by using the other lead test cable.

(5) Make a copy of the Threshold setup spreadsheet and place it in Traveler for both leads along with a copy of this form.

(6) The quench management cables for stand 3 will always remain connected to the QM box. These cables include quench characterization for the positive and negative lead and quench detection for the positive and negative lead. There are six cables that need to be connected from stand 4. These include FVTLD1, FVTLD2, FVT+LEAD, FVT-LEAD, FVT WC 1/2C M1, and FVT WC 1/2C M2. These cables should be plugged into the corresponding connectors on QM box.

16. Cold test of the power leads

Performed by ROGER RABEHL/MIKE TARTAGLIA Roger Rabehl
(name typed) (signature)

Date & time JULY 25, 2003 1200

Power Lead 7500 A DFLX 33 & 7500 A DFLX 34

16.0 Set the DAQ system ScribeLeads and ScribeFix32 Data Logging Intervals to capture data every 10 seconds.

16.1. Establish cryogenic parameters for normal high current operating conditions.
Set the liquid level at 6in location using the 1 foot LL probe ✓
Set the copper section inlet cooling gas temperature to 15-20K range ✓
Set the LHe vapor cooling control loop in automatic mode to keep the upper HTS terminal temperature at 45 K for ½ hour ✓
Set the upper HTS temperature to 50 K and keep it there for ½ hour ✓

16.1.1 Set software quench detection thresholds by executing:
✓ /usr/vmtf/sh/lhchts_setquenchthreshhold_run.sh

16.2 Stair step profile test.
Turn on the Power Supply. Set HTS terminal temperature to 50K and apply current profile 1 ✓
Monitor voltages and make sure that the data is recorded.
Run data analysis tool on the obtained data file to determine joint resistances.

7500 A DFLX 33 R(joint1) = $\frac{0.0003\ V}{7500\ A}$ = 40 nΩ (V2 - V3)
R(joint2) = $\frac{0.000036\ V}{7500\ A}$ = 4.8 nΩ (V3 - V4)

7500 A DFLX 34 R(joint1) = $\frac{0.0003\ V}{7500\ A}$ = 40 nΩ (V2 - V3)
R(joint2) = $\frac{0.000023\ V}{7500\ A}$ = 3.1 nΩ (V3 - V4)

16.3 Coolant loss test.
Apply 7500 A and
a) Close the coolant flow for 7500 A DFLX 33 (NEG. LEAD)
Wait until QD detects the quench and record
T1 = 86 K ; T2 = 317 K; V12 = -0.104 V ; V23 = -0.00172 V ; V~~24~~34 = 0.000118 V

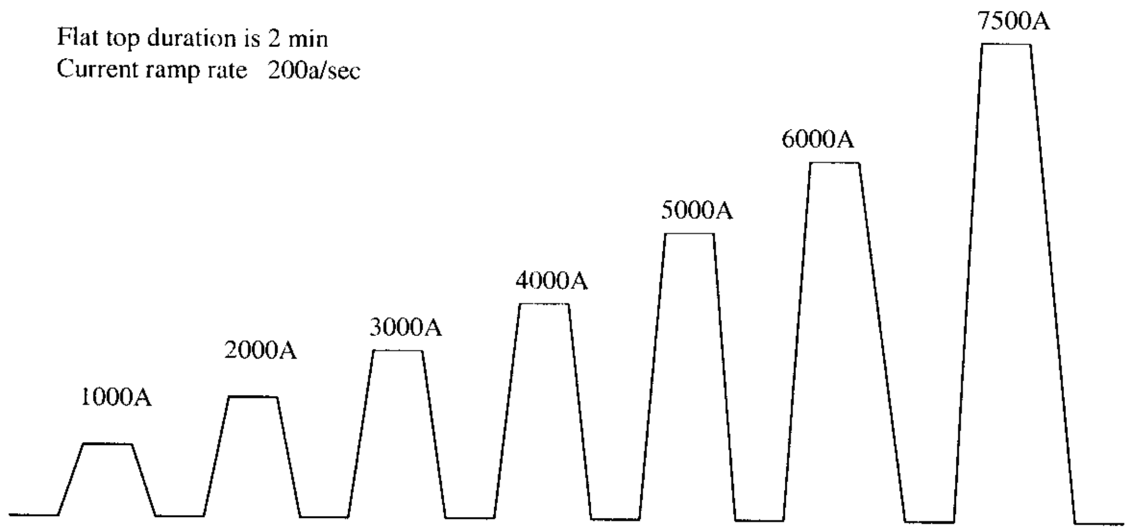
b) Re-establish operating conditions
c) Close the coolant flow for 7500 A DFLX 34 (POS. LEAD)
Wait until QD detects the quench and record
T1 = 78 K ; T2 = 288 K; V12 = 0.094 V ; V23 = 0.00087 V ; V~~24~~34 = 0.000306 V

16.4 Set the upper HTS terminal temperature to 45 K and apply 7500 A apply current profile 2. Set HTS terminal temp to 50 K and apply current profile 2.

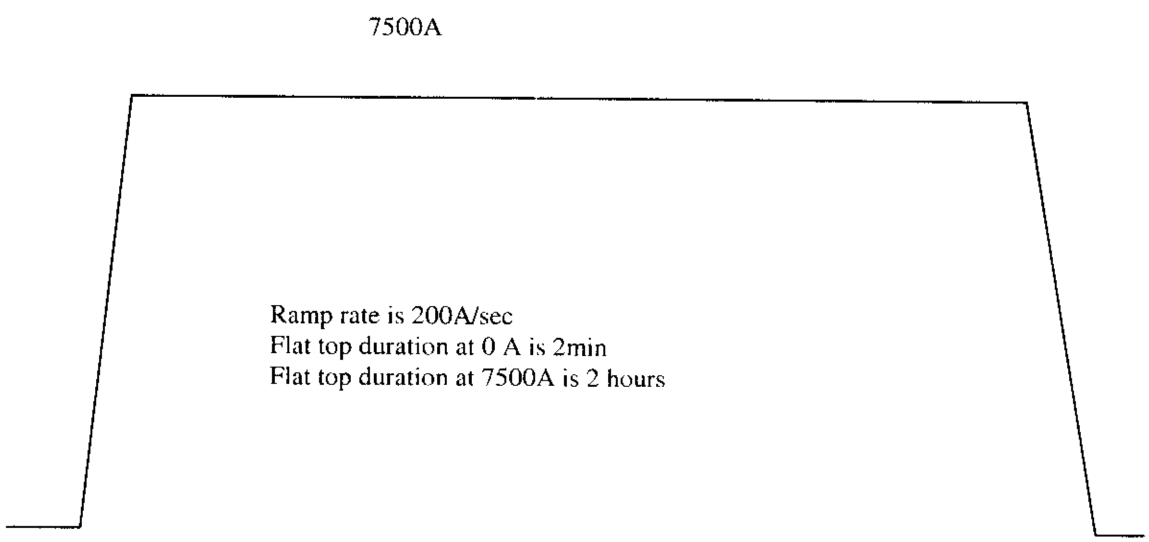
16.5 When test is completed, set the ScribeLeads and ScribeFix32 Data Logging Intervals to 300 seconds.

Note: If any irregularity occur call Sandor.

Profile 1:



Profile 2:



FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date:April 2, 2003 Page 1 of 2 Author: Sandor Feher
	16. Cold test of the power leads	

Performed by ROGER RABEHL (name typed) Roger Rabehl (signature)

Date & time JULY 28, 2003 1200

Power Lead 7500 A DFLX 33 & 7500 A DFLX 34

16.0 Set the DAQ system ScribeLeads and ScribeFix32 Data Logging Intervals to capture data every ~~10~~ 5 seconds.

16.1. Establish cryogenic parameters for normal high current operating conditions.
Set the liquid level at 6in location using the 1 foot LL probe ✓
Set the copper section inlet cooling gas temperature to 15-20K range ✓
Set the LHe vapor cooling control loop in automatic mode to keep the upper HTS terminal temperature at 45 K for ½ hour ✓
Set the upper HTS temperature to 50 K and keep it there for ½ hour ____

16.1.1 Set software quench detection thresholds by executing:
✓ /usr/vmtf/sh/lhc_setquenchthreshold_run.sh

16.2 Stair step profile test.
Turn on the Power Supply. Set HTS terminal temperature to 50K and apply current profile 1 ✓
Monitor voltages and make sure that the data is recorded.
Run data analysis tool on the obtained data file to determine joint resistances.

7500 A DFLX 33 R(joint1) = $\frac{0.0003\ V}{7500\ A}$ = 40 nΩ (V2-V3)
R(joint2) = $\frac{0.000027\ V}{7500\ A}$ = 3.6 nΩ (V3-V4)

7500 A DFLX 34 R(joint1) = $\frac{0.00028\ V}{7500\ A}$ = 37 nΩ (V2-V3)
R(joint2) = $\frac{0.000027\ V}{7500\ A}$ = 3.6 nΩ (V3-V4)

16.3 Coolant loss test.
Apply 7500 A and
a) Close the coolant flow for 7500 A DFLX 33
Wait until QD detects the quench and record
T1 = 80 K ; T2 = 315 K; V12 = -0.100 V; V23 = -0.0008 V; ~~V24~~ V34 = 0.00024 V
b) Re-establish operating conditions
c) Close the coolant flow for 7500 A DFLX 34
Wait until QD detects the quench and record
T1 = 79 K ; T2 = 302 K; V12 = 0.0978 V; V23 = 0.00104 V; ~~V24~~ V34 = 0.00040 V

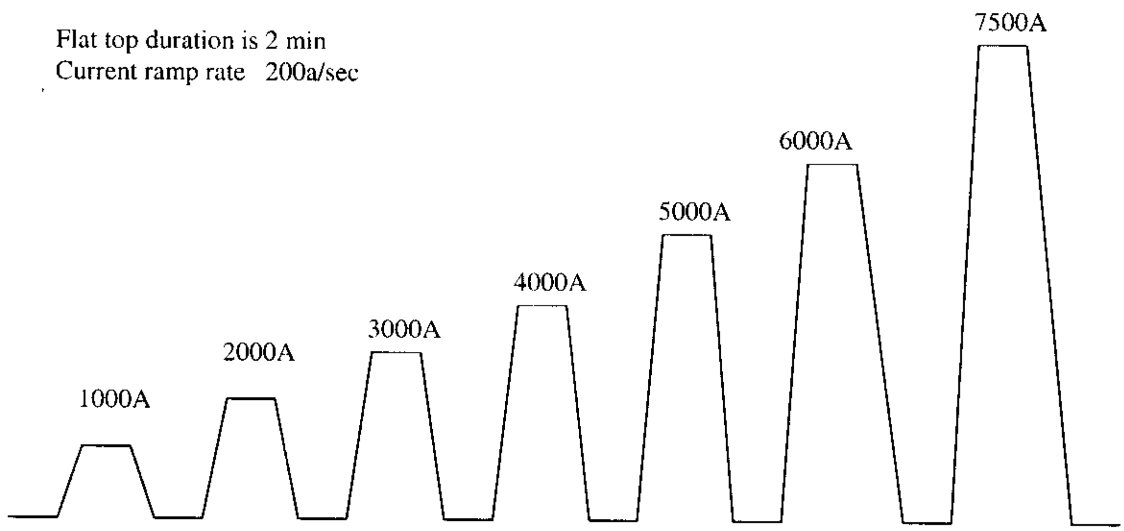
16.4 Set the upper HTS terminal temperature to 45 K and apply 7500 A apply current profile 2. Set HTS terminal temp to 50 K and apply current profile 2.

16. Cold test of the power leads

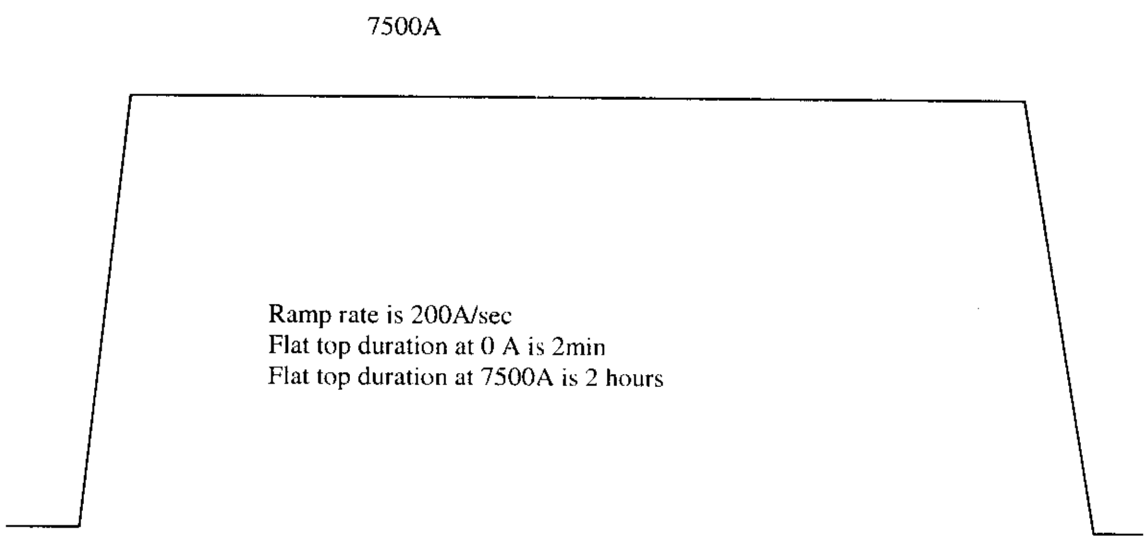
16.5 When test is completed, set the ScribeLeads and ScribeFix32 Data Logging Intervals to 300 seconds.

Note: If any irregularity occur call Sandor.

Profile 1:



Profile 2:



FERMILAB Technical Division	7500A HTS Power leads for the LHC DFBX	Doc. No. Rev. No. Date: March 5,2003 Page 1 of 1 Author: Dan Eddy
	20. Warm Temp Hi-pot In Gasous He Environment	

Note: Save the shipping container for storing and moving the leads around TD and after the test is complete to ship them to the DFBX manufacturer.

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Performed by Dan W (Name typed) Dan W (Signature)

Date & time 7-29-03

Pos. Power Lead 7500 A DFLX 34 and Neg. Power Lead 7500 A DFLX 33

This hi-pot should be performed after dewar has been filled with gaseous helium after the second test cycle has been completed and the dewar is at room temperature. When checkout is complete, make sure you place the original and a copy of this document in the Traveler Binders.

3.1 Short all of the temperature sensors together using the special RTD high pot cable. High pot each set of temperature sensor to 300v with respect to the Lead (ground).

Record breakdown voltage (if any) — V.
Record current .01 u A

3.2 Hi-pot the leads in a cold (4.5K) He environment to 1500V (1.3 Bar) using a Droege HV power supply. Connect the positive clip to one lead and the negative clip to ground. Also, short all of the temperature sensors together using the special RTD high pot cable. Connect the ring terminal from each connector to the flag of each lead. **Be sure to disconnect the redundant voltage taps on both leads and the power connections from Kepco power supply.**

Record breakdown voltage (if any) — V.
Record current .02 u A.
Record approximate temp. 295 K.
Record approximate dewar pressure .2 PSIG.
PI520-3 14.8 PSIA

FERMILAB
Technical Division

Stand 3 LHC-HTS Lead Testing: 23. Pack and Ship the Leads

Lead Pair

Negative Lead: DFLX 33

Positive Lead: DFLX 34

Signed Roger Rabehl Date 7/31/03

1. **Pack the Leads**
   1.1 With the lead on the steel table, swing the insertion/lifting tool 180° so that the lead can be picked up and remain horizontal as shown in Figure 1.1.

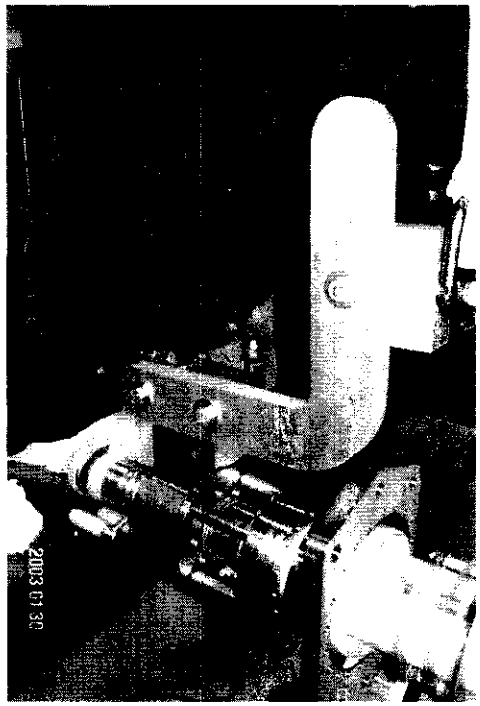

Figure 1.1 Orientation of the insertion/lifting tool to allow the power lead to be held horizontally.

1.2 Lift the power lead off of the steel table.
1.3 While supporting the lead from the crane, remove the end support clamped around the lower flange of the power lead.
1.4 Complete the lead preparation checklist:

✓ ✓ **a)** Install the protective covers for the lead top plate knife edge sealing surface and for the lower flange sealing surface on each lead. Secure them with tape.

✓ ✓ **b)** Insert a protective plastic cap into the 4-20 K gas port for each lead.

✓ ✓ **c)** Reattach the g-force indicators that were attached to the leads when they arrived.

✓ ✓ **d)** Wrap the ceramic insulator at the top of each lead in bubble wrap.

✓ ✓ **e)** Place a cap on the Conflat flange at the top of each lead.

Negative Lead DFLX 33 Positive Lead DFLX 34

✓ ✓ f) Wrap the power lead vacuum pumpout in aluminum foil.

✓ ✓ g) Secure the power lead bus and voltage tap wires to the power lead lower G-10 section with tape.

✓ ✓ h) Set each lead in the shipping crate and remove the insertion/lifting tool.

1.5 Complete the packing checklist:

✓ **a)** Reinstall the wooden supports in the crate to hold the lead in place during shipping.

✓ **b)** Make two photocopies of all documents in the lead travelers, and place the power lead travelers in the shipping crate. One copy of the documents is for Sandor, the second copy is for Marsha Schmidt.

✓ **c)** Verify the following items are in the shipping crate:

✓ **i)** Two flag heaters

✓ **ii)** Two flag heater connectors

✓ **iii)** Vacuum pumpout actuator

✓ **iv)** NW16 clamp

✓ **v)** NW16 o-ring

1.6 Close the shipping crate

2. Ship the Leads

2.1 Complete the shipping checklist:

✓ **a)** Call Marsha Schmidt (X-4377) to request that the power leads be shipped to storage.